

**INVESTIGATION CONCLUSION
ANOMALOUS SOIL SAMPLES
AT HUNTERS POINT NAVAL SHIPYARD
REVISION 1**

April 2014

**HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA**



**TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, California 92101-8536**

INVESTIGATIVE TEAM AND METHODS

TtEC initiated the investigation to evaluate potential causes for the discrepancy. The investigation team consisted of:

- Erik Abkemeier, PE, CHP, CSP, CHMM, Nuclear Regulatory Commission (NRC) license Radiation Safety Officer (RSO)
- Greg Joyce, CQM, Program Quality Control Manager
- Adam Berry, Radiation Safety Officer Representative
- Rich Kanaya, Project Quality Control Manager
- Rick Weingarz, Assistant Project Manager

For this RCA, the investigative team used potholing, additional subsurface analysis, database review, on-site interviews, and visual comparison of soil samples.

CHRONOLOGY OF EVENTS/TIMELINE

October 5, 2012

B517 SU-002 Subsurface Investigation

Because the composition of the backfill within Parcel E may consist of bedrock debris and the depth of the actual bedrock can be extremely variable, the first step in the investigation was to determine if the set of systematic samples with the anomalous readings was collected from a specific layer in the subsurface that may or may not have been at the depth prescribed for sampling. The sampling depth for the systematic samples, as described in Standard Operating Procedure (SOP) HPO-Tt-009, is 15 centimeters (6 inches) bgs. The SOP is included as Attachment 4.

B517 SU-002 was located and marked out by TtEC on-site engineers. Final systematic sample locations and associated building footprints (B-509/B-517) were also located and marked. Once all markings were completed, stakes and rope were erected to establish a perimeter around SU-002. Signs reading “Do Not Enter” were hung around the perimeter to negate foot and equipment traffic.

October 5 to 8, 2012

Locations #141, #148, #149, and #155 Potholes

On October 8, 2012, potholes were excavated with a backhoe to a depth of 3 feet bgs at four of the sample locations with anomalous results (#141, #148, #149, and #155) to identify lithology (Figure 1). Excavation at each location was performed in 6-inch lifts, with photographs and measurements collected between lifts. A geologist was present to aid in the identification of lithology. Multiple lithologies were encountered in each pothole. This created distinct layers of differing material types which varied with depth. A summary of the initial investigation and photographs of the sample locations potholed are included in Attachment 5.

In tandem with securing the B517 SU-002 area on October 5, all archived samples taken from the survey unit were pulled aside and secured for comparison with the lithology observed in the potholes. In general, the archived samples are light gray in color. Photographs of samples pulled from the archive for locations #141, #148, #149, and #155 are included in Attachment 5.

The samples matched the lithology at only one location (#155) where a lens of light grayish bedrock material was observed. The hypothesis that individuals sampling soil may have either consciously or accidentally sampled bedrock soil that had low concentrations of K-40, Ra-226, and its progeny was not supported by observations from the potholing at locations #141, #148, and #149.

October 16, 2012

B517 SU-002 Subsurface Sampling

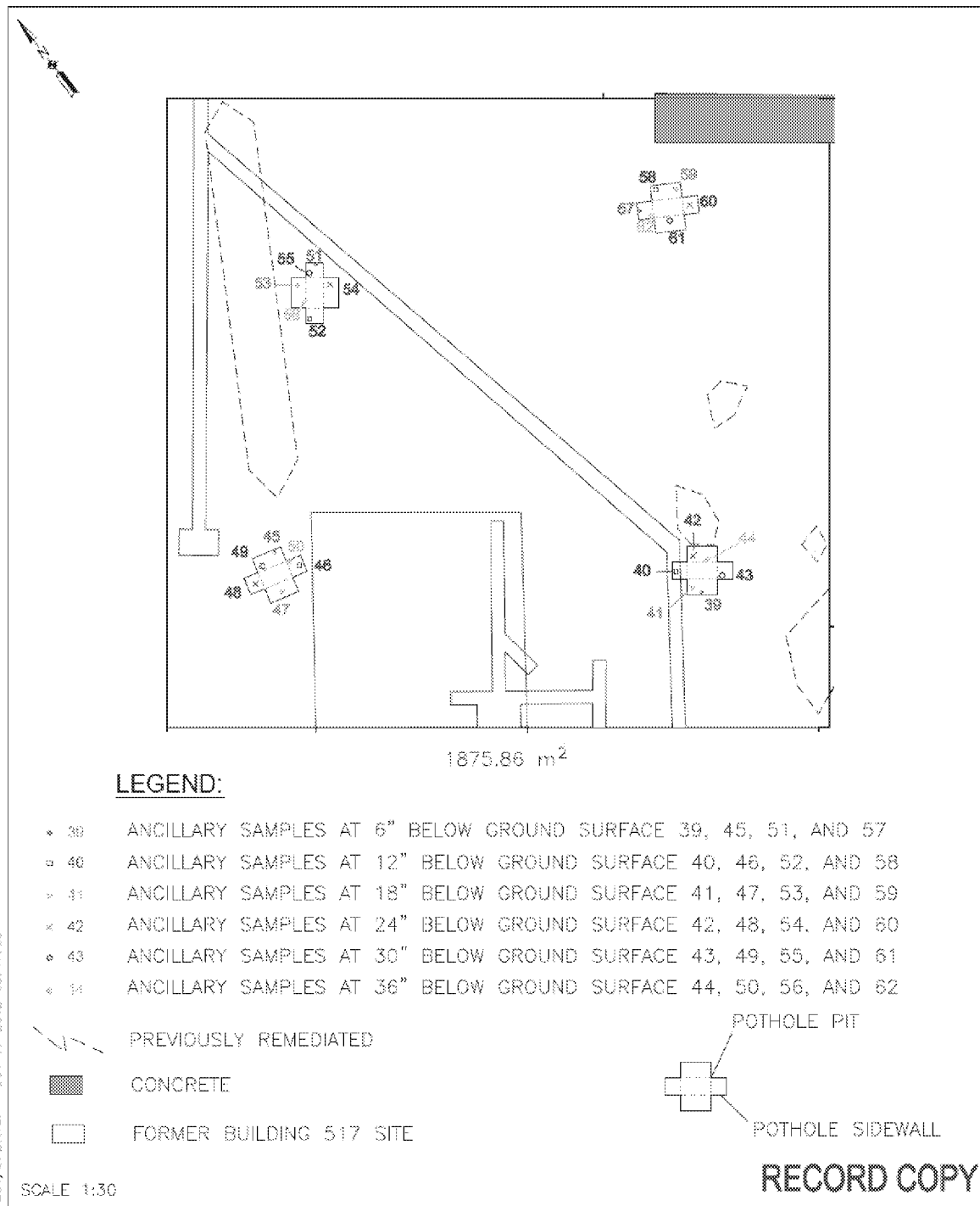
Since the potholing was not conclusive at locations #141, #148, #149, and given the potential for variability in fill materials that may be present across B517 SU-002, additional locations in different quadrants of B517 SU-002 were potholed using a backhoe and sampled on October 16, 2012. The potholes were advanced in 6-inch intervals to a depth of 3 feet bgs. Samples were collected at 6-inch intervals to acquire information about the radionuclide concentrations at multiple depths to verify if sampling technique may have been a factor in the anomalous soil sample results. All sampling was verified and documented by an independent party, Rich Kanaya, Project Quality Control Manager, in surveillance reports included as Attachment 6. Photographs of the potholes are included as Attachment 7.

A summary of the Bi-214, Pb-214, Ra-226, and K-40 concentrations is provided in Table 1. A pothole sample map is shown as Figure 2.

TABLE 1
FORMER BUILDING 517 SITE SU-002 INVESTIGATIVE POTHOLE RESULTS

	Sample ID	Bi-214	Pb-214	Ra-226	K-40
6 inches	07AB517-039	0.334	0.4707	0.7022	11.09
	07AB517-045	0.4849	0.6182	0.9035	11.89
	07AB517-051	0.4115	0.5577	0.819	13.81
	07AB517-057	0.3598	0.2577	0.5537	11.45
12 inches	07AB517-040	0.4547	0.4334	0.7448	12.73
	07AB517-046	0.9698	0.9118	1.245	12.45
	07AB517-052	0.2658	0.3691	0.3634	10.76
	07AB517-058	0.3278	0.2753	0.5787	12.08
18 inches	07AB517-041	0.3203	0.4782	0.752	11.77
	07AB517-047	0.07622	0.1602	0.4654	9.22
	07AB517-053	0.3269	0.3247	0.6957	7.926
	07AB517-059	0.101	0.1701	0.6186	8.725
24 inches	07AB517-042	0.01964	0.02277	0.06388	0.476
	07AB517-048	0.04757	0.1221	-0.1024	10.2
	07AB517-054	0.3334	0.2329	0.5851	6.622
	07AB517-060	0.4268	0.3673	0.5442	12.14
30 inches	07AB517-043	0.1168	0.1369	0.1389	5.773
	07AB517-049	0.1962	0.2484	0.4376	8.74
	07AB517-055	0.1217	0.1549	0.4367	8.374
	07AB517-061	0.08145	0.1993	0.1689	6.603
36 inches	07AB517-044	0.08985	0.1425	0.6409	10.85
	07AB517-050	0.6213	0.591	1.016	9.783
	07AB517-056	0.2989	0.3047	0.3685	10.39
	07AB517-062	-0.02878	0.06787	0.1407	4.778
	K-40 < 5 pCi/g				

FIGURE 2
POTHOLE SAMPLE MAP



HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CA
P.O. BOX 884836
SAN FRANCISCO, CA 94188

500 SERIES SURVEY UNITS
CLASS 1 SURVEY UNIT
517 SU-02



TETRA TECH EC, INC.
1230 COLUMBIA STREET, SUITE 750
SAN DIEGO, CA 92101
TEL: (619) 234-8590 FAX: (619) 234-8591

The complete set of soil sample results is available upon request.

Given that all 36 final systematic samples collected on April 10, 2012, in B517 SU-002 showed K-40 at concentrations less than 5 pCi/g, it would be expected that sample results from the four quadrant locations at 6-inch intervals to depths of 3 feet bgs would have similar results. However, only two locations had results similar to the final systematic results, and both of these locations were significantly deeper than the targeted 6 inches bgs.

B517 SU-002 Subsurface Investigation Conclusions

The hypothesis that individuals sampling soil may have either consciously or accidentally sampled bedrock soil that had low concentrations of K-40, Ra-226, and progeny was not supported by observations from the potholing or the subsurface sampling. No lithological evidence suggests that a bedrock soil layer exists, light gray in color, that is contiguous across B517 SU-002 at depths less than 2 feet bgs, which would account for anomalous readings in all 36 final systematic sample locations. In addition, even though two results from subsurface sampling were similar to the anomalous K-40 results, neither sample was located at a depth that could be credibly attributed to misjudging a 6-inch sampling depth.

October 16, 2012

Investigation to Identify Other Sites with Low K-40 Data

While waiting for the results from the subsurface sampling, the NRC licensed RSO, Erik Abkemeier, and others reviewed soil sample data collected from other HPNS sites surrounding the Former Building 517 Site. The review looked specifically for soil samples with K-40 concentrations less than 5 pCi/g.

Previous to this investigation, patterns of radionuclide concentrations were not specifically analyzed by anyone on the HPNS team. Concentrations of Ra-226 and its progeny were carefully monitored on gamma spectroscopy results to ensure that the Ra-226 release criterion was not exceeded. As K-40 is not a radionuclide of concern, K-40 concentrations were not monitored other than in conjunction with evaluating gamma scan and static readings that appear more elevated than usual but do not exhibit elevated concentrations of any of the radionuclides of concern.

October 15 through 19, 2012

Database Review

From October 15 through October 19, Erik Abkemeier, George Chiu, and Thorpe Miller reviewed soil sample results from the on-site database, as well as survey unit sampling maps. The review was to:

- Identify areas with similar anomalous K-40, Ra-226, and progeny concentrations that do not correlate with previous samples in the area in the event that multiple soil sample sets were collected.
- Evaluate soil sample sets exhibiting similar radionuclide concentrations that appear divergent from other soil samples in the area.

The key radionuclides, sampling date, and individual listed as the sample collector on the sample chain of custody are provided in the spreadsheets in Attachment 3. Note that not all survey units

listed in the spreadsheet show anomalous soil sample results. Some survey units are listed for comparison of soil sample results for other survey units in the same general area.

The review of the data showed a pattern of consecutive samples with uncharacteristically low K-40, Ra-226, and progeny concentrations in 12 survey units at 3 additional sites in the Parcel C and E areas. In many of these areas, previous systematic samples collected in the same vicinity did not show the same low K-40 concentration. As these anomalies are consistent with the K-40 sample concentrations as evidenced in B517 SU-002, the scope of the investigation was expanded to cover other survey units.

October 24 through November 28, 2012

Additional Systematic Sampling

From October 24 through November 28, the HPNS team took action to collect systematic samples in these areas to determine if the radionuclide signature of low K-40, Ra-226, and progeny could be replicated. An additional surveillance was conducted by Greg Joyce on October 24, 2012, for B517 SU-002. The surveillance report is contained in Attachment 8. A listing of survey units that warranted further investigation is provided as Table 2. Soil sample survey maps for the former Building 517 Site, Building 707 Triangle Area (707 Area), Shack 79/80, and North Pier are included in Attachment 3.

TABLE 2
SURVEY UNITS RECOMMENDED FOR RESAMPLING

Area	Survey Unit	Sample Numbers	Date Collected	COC Radiological Technician
517	2	123-158	10-Apr-12	Jeff Rolfe
707	9	59-78	08-Jun-11	Jeff Rolfe
707	16	67-86	07-Jun-11	Jeff Rolfe
707	17	64-83	08-Jun-11	Jeff Rolfe
707	22	81-100	12-Aug-12	Anthony Smith
707	23	5-24	31-Jul-12	Jeff Rolfe
North Pier	1	28-47	31-May-12	Ray Roberson
North Pier	7	30-49	04-Jun-12	Justin Hubbard
North Pier	8	32-51	31-May-12	Ray Roberson
North Pier	10	27-46	31-May-12	Ray Roberson
North Pier	11	27-46	31-May-12	Ray Roberson
79/80	2	3, 5-6, 8-22	04-Apr-12	Jeff Rolfe

Additional Systematic Sampling Results

Results, including calculation of the mean, median, and standard deviation values for the complete systematic sample data sets, are contained in the spreadsheets of Attachment 3. The systematic sample results collected as a result of this investigation are substantially more elevated than the anomalous set of systematics, suggesting that the anomalous set of systematic samples is not representative of its respective survey unit.

For example, in the set of final systematic samples from B517 SU-002 that led to this investigation, the mean, median, and standard deviation for K-40 concentrations were approximately 1.78 pCi/g, 1.75 pCi/g, and 0.6 pCi/g, respectively. The set of systematic samples collected as part of this investigation on October 24, 2012, produced results for K-40

concentration mean, median, and standard deviations of 15.16 pCi/g, 14.77 pCi/g, and 5.13 pCi/g, respectively.

Note that in some cases, such as in the Shack 79/80 Survey Unit 2, soil samples collected as a result of the anomalous set of systematic samples identified radionuclides of concern at a level exceeding a radionuclide-specific release criterion. In these cases, additional characterization samples were collected to bound the extent of contamination and remediate the affected area. These soil sample results are included in Attachment 3 as well.

Table 3 is a listing of survey units showing some low K-40 concentrations but not exhibiting the need for collection of an entire systematic sample set, due either to a mix of more elevated K-40 concentrations and/or no other sets of samples that conflict the low K-40 results. These survey units warrant further review and may require resampling.

TABLE 3
SURVEY UNITS WITH LOW K-40 CONCENTRATIONS FOR POSSIBLE
RESAMPLING

Area	Survey Unit	Sample Numbers	Date Collected	COC Radiological Technician
500	3	45-56	4/4/12, 4/13/12	Jeff Rolfe/Anthony Smith
707	3	37-56	24-Feb-11	Jeff Rolfe
707	13	31-50	4-Mar-11	Jeff Rolfe
Parcel C Trench	234	1-18	18-Nov-11	Joe Cunningham
Parcel C Trench	238	18-35	12-Apr-12	Joe Cunningham
Parcel C Trench	242	25-42	17-Apr-12	Joe Cunningham
Parcel C Trench	302	5-22	22-May-12	Joe Cunningham

Note that the Building Area 500, Survey Unit 3 samples are the result of post-remediation samples collected at a deeper point than surface samples. The final set of systematics in that survey unit showed a typical radionuclide concentration distribution for K-40, Ra-226, and progeny. These samples lend credence to the possibility that soil samples from B517 SU-002 were dug below a depth of 6 inches. As that theory has been effectively disproven, these soil samples are questionable as well.

Additionally, the Parcel C trenches listed in Table 3 have been backfilled and are not easily accessible. Because trenches to remove pipe are at a depth that frequently intersects with the native bedrock soils, there is a possibility that the soil type at which the trench samples were collected is of a uniform naturally occurring radionuclide concentration, such that the samples are all valid; however, these trenches do have sets of final systematic samples that are anomalous when compared to other survey units. Recommendations regarding these trenches are included in Attachment 19.

Week of November 5, 2012

On-Site Interviews and Examination of Samples

Because laboratory error and the presence of a near-surface contiguous bedrock soil were ruled out as a possible cause for the B517 SU-002 discrepancy and results from vertical sampling and another set of systematic samples, collected within feet of the anomalous locations, did not report

similar low K-40 results, the next step was to investigate the potential of human error as the cause for the discrepancies.

During the week of November 5, 2012, Erik Abkemeier and Greg Joyce conducted investigations at HPNS consisting of:

- Interviews with individuals listed on the chains of custody for the anomalous soil samples listed in Table 2, as well as direct supervisors, members of the sampling crews, and individuals listed on the receiving end of the soil samples at the Curtis and Tompkins on-site laboratory
- Inspection of the sites with anomalous systematic sample sets to determine the homogeneity of surface soil type as well as examine the soil strata in the potholes dug in B517 SU-002
- Visual comparison of all sets of systematic soil samples collected at B517 SU-002

Interviews with Personnel

Interviews were conducted with a predetermined set of questions, including prompts for any knowledge of improprieties or unethical behavior, as well as a lead-in by Erik Abkemeier and Greg Joyce describing the situation, the seriousness of the situation, and the likelihood of follow-up questions from other entities. Individuals were often asked follow-up questions to further understand the sample collection, sample receipt, or sample preparation process, as well as to probe for any direct or indirect pressures. A synopsis of the interview with each individual is included in Attachment 9.

Field Employees

The individuals interviewed as a part of the teams collecting soil samples in the field consisted of TtEC Health Physics Supervisors, Steve Rolfe and Justin Hubbard; Radiological Survey & Remedial Services, LLC (RSRS) subcontracted Radiation Control Technicians (RCTs), Jeff Rolfe and Ray Roberson; and TtEC laborers Jorge Colonel, Reggie Young, and Jeff Langston. Although listed on the chains of custody for some anomalous systematic soil sample survey units, Anthony Smith and Joe Cunningham were not interviewed as they were no longer working at the HPNS project site at the time of the investigation. Shortly after this investigation, Ray Roberson passed away.

From these interviews, the following points were corroborated consistently:

- Only HPNS Health Physics Supervisors or RCTs fill out chain-of-custody paperwork.
- HPNS Health Physics Supervisors give direction on what tools to use, consisting of picks, shovels, chipper hammers, and sometimes backhoes for hard surfaces, as well as what depth to collect the samples.
- Sample locations are selected using Visual Sample Plan software as described in the approved work plans. Engineers provide a map and orange markings with numbers on the ground in each survey unit to mark areas where samples are to be collected and field crews sampled only where the sample location was marked.
- Only one to two sets of survey unit samples could be collected in one day. Collecting greater numbers of samples would be difficult.

- No one knew of any sample collection outside the points that samples were marked to be collected or of sampling outside the survey unit sites.
- The teams were under no pressure or schedule deadlines for completing survey units. The only indication of any sense of urgency came from Steve Rolfe, who had been told that there had been no completed work that could be invoiced for Parcel E in some time.

During these interviews, both Justin Hubbard and Ray Roberson stated that collection of more than two sets of systematic samples in one day would be difficult. However, the investigation revealed that Ray Roberson was listed on chains of custody for four sets of systematic samples from the North Pier, which is extremely rocky and difficult to sample, as well as an additional trench segment survey unit, all on May 31, 2012. These chains of custody are in conflict with the statements made by these two individuals.

Laboratory Employees

The individuals interviewed as a result of being listed on the chains of custody for sample receipt of anomalous systematic soil samples at the Curtis and Tompkins on-site laboratory were Phil Smith and Robin Fluty, laboratory supervisors, and Jeff Fluty, Andy Alexander, and Jon Alexander, laboratory technicians. All are Curtis and Tompkins employees.

For these interviews, the following points were consistently corroborated:

- Verifying the sample bag numbers against the chain-of-custody forms is an established process.
- Sample preparation is an established process.
- Sample bags are stored in the receipt or processing Conex to which only the laboratory technicians and laboratory manager have lock access.
- The Conex is never left unattended or unlocked.
- Laboratory employees have minimal knowledge of where soil samples are collected in the field.
- Laboratory employees have minimal knowledge of whether specific soil samples are above or below a release criterion for a radionuclide of concern.
- All laboratory technicians can perform all functions, all sample receipt, sample analysis, and gamma spectroscopy.

Other HPNS Employees

Additionally, Bryan White, Basewide HPNS Supervisor at the time of investigation and former Radiological Quality Control personnel, and Jarvis Jensen, Health Physicist, were interviewed. Bryan White provided background and insight into the manner in which soil samples are typically collected, as he had performed quality control surveillances of the evolution in the past. He knew of no intentional soil tampering, and did not believe anyone on-site would engage in such an activity. Jarvis Jensen was not aware of any known or rumored soil sample tampering. He had originally suspected the anomalous soil sample results found in the B517 SU-002 had been the result of digging too deep because he believed it was fairly common knowledge among the RCTs that the “blue-green” serpentinite rock provided favorably low Ra-226 results.

November 7, 2012

Inspection of Sites with Anomalous Data

On November 7, 2012, Erik Abkemeier and Greg Joyce accompanied Construction Manager Dennis McWade and Radiation Safety Officer Representative Adam Berry to inspect B517 SU-002, various import fill piles, the North Pier, and the 707 Site.

Examination of Soil Surfaces at Former Building 517 Site, Survey Unit 2

A visual inspection of the surface soils at B517 SU-002 showed that there appears to be a number of different soil types throughout the surface area, of which little appears to match the gray soil from the anomalous set of systematic samples. Additionally, the four potholes contained materials in a variety of colors, but the depths were not consistent. Therefore, collecting an entire set of 36 systematic samples in a contiguous soil stratum at depth, by accident, seemed unlikely.

Examination of Import Fill Piles

The same individuals visited the site of several import fill piles to look for soil that appeared similar to the soil of the anomalous B517 SU-002 samples. Soil samples collected for gamma spectroscopy analysis from the import fill piles did not have any results similar to the anomalous sample results.

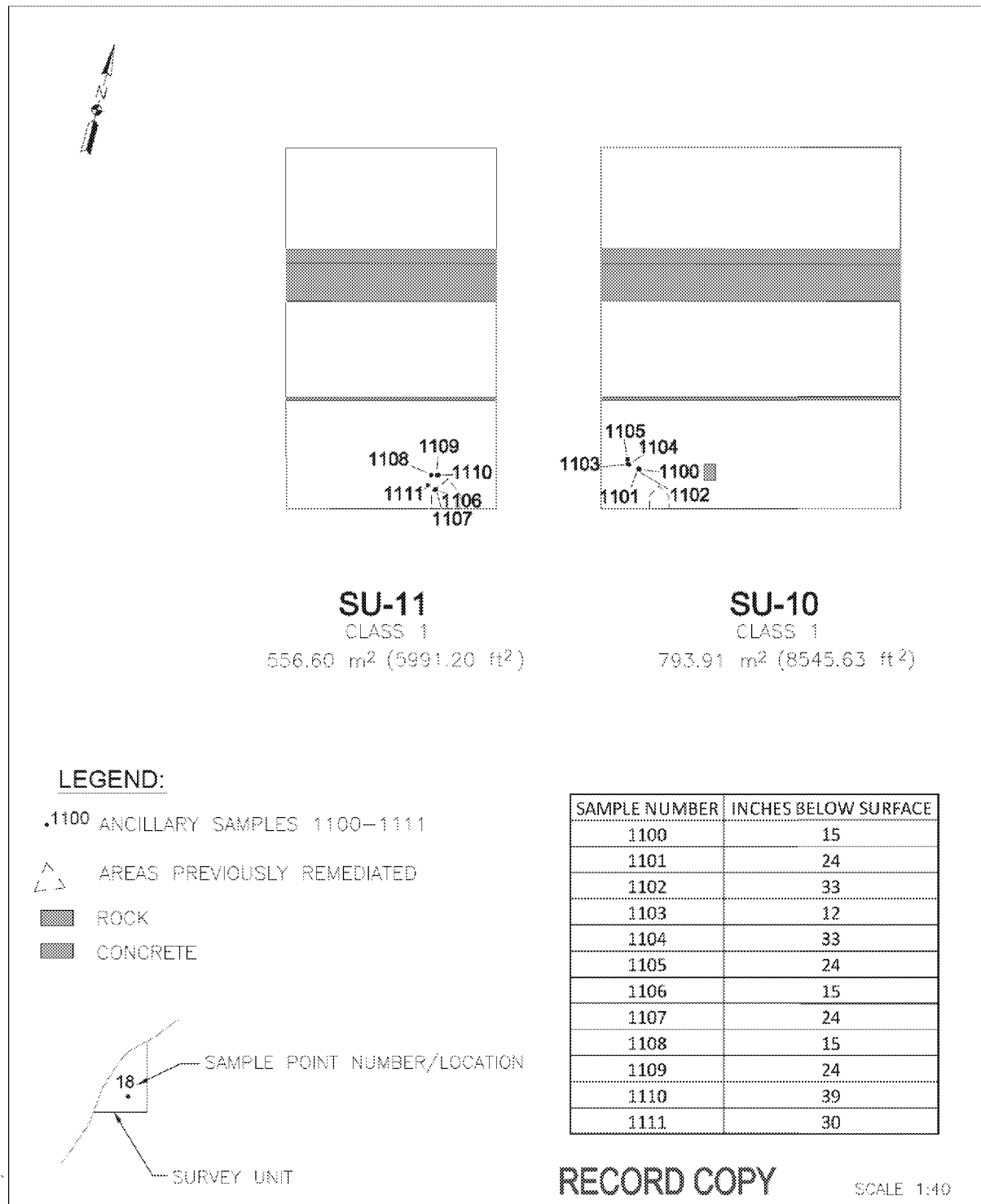
Examination of North Pier

The North Pier had been covered by crushed asphalt at the conclusion of remediation several months earlier; however, it was evident where samples had been collected as part of the investigative process. A test pit was dug to a depth of 3 feet bgs. The soil beneath the asphalt was a mixture of rocks, gravel, and clays, and was not consistent throughout the area. Results from the test pit on the North Pier are shown in the following Table 4, and sampling locations are shown on Figure 3. Photographs are provided in Attachment 10. No results at any depth were comparable to the anomalous soil samples with low concentrations of K-40, Ra-226, and progeny.

TABLE 4
NORTH PIER TEST PIT SAMPLES COLLECTED TO A DEPTH OF 3 FEET

Sample ID	K-40 (pCi/g)	Ra-226 (pCi/g)	Cs-137 (pCi/g)	Bi-214 (pCi/g)	Pb-214 (pCi/g)
07A-SB04-002	13.73	0.5723	0	0.5101	0.4946
02ANPR-1100	6.796	0.3756	-0.01209	0.0923	0.2235
02ANPR-1101	9.391	0.3323	-0.008652	0.2755	0.4686
02ANPR-1102	9.294	0.4989	-0.006876	0.4131	0.3777
02ANPR-1103	6.227	0.3655	-0.0004954	0.09775	0.1739
02ANPR-1104	8.076	0.3324	0	0.3696	0.2369
02ANPR-1105	8.011	0.1466	0	0.3387	0.3623
02ANPR-1106	10.64	0.5653	-0.006999	0.3513	0.4925
02ANPR-1107	10.51	0.4341	0.007666	0.3817	0.5214
02ANPR-1108	17.77	1.359	0.01339	0.4399	0.5899
02ANPR-1109	6.758	-0.1163	-0.004885	0.1066	0.2448
02ANPR-1110	7.906	0.4756	0.004713	0.143	0.2897
02ANPR-1111	7.847	0.5883	0.001557	0.3008	0.3195

FIGURE 3
NORTH PIER SAMPLE LOCATIONS



HUNTERS POINT SHIPYARD
SAN FRANCISCO, CA
P.O. BOX 884836
SAN FRANCISCO, CA 94188

NORTH PIER WA-32
SURVEY UNIT 10



TETRA TECH EC, INC
1230 COLUMBIA STREET, SUITE 750
SAN DIEGO, CA 92101
TEL: (619) 234-8690 FAX: (619) 234-8591

Examination of Site 707

Due to performance of the Task-specific Plan for the Building 707 Triangle Area Remedial Action Support and Final Status Surveys, the 707 Site had varying degrees of remediation performed, so that there were different depths across the area. An exposed layer of “road base,” looked similar in color (gray) and composition (relatively homogeneous) to the soil samples from B517 SU-002. Photographs are provided in Attachment 11, and sample locations are shown on Figure 4. Samples of the road base were analyzed, and results are shown in Table 5.

FIGURE 4
SITE 707 TRIANGLE MAP

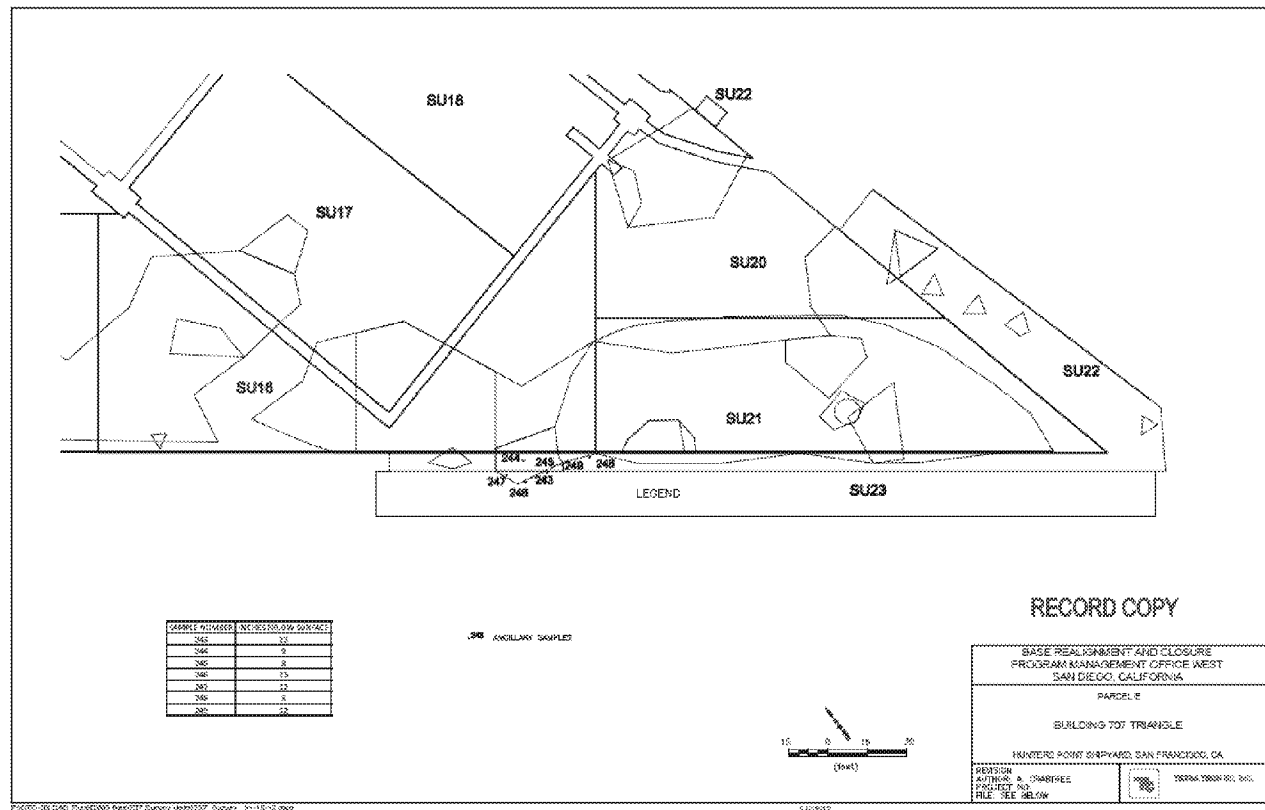


TABLE 5
SITE 707 ROAD BASE SAMPLE RESULTS

Sample ID	K-40 (pCi/g)	Ra-226 (pCi/g)	Cs-137 (pCi/g)	Bi-214 (pCi/g)	Pb-214 (pCi/g)
03AB707-243	0.9625	-0.0327	0	0.04739	0.05083
03AB707-244	10.66	0.2727	0.0003179	0.2967	0.2651
03AB707-245	1.387	-0.005944	0	0.05911	0.003418
03AB707-246	1.767	0.1753	-0.003111	0.04795	0.1434
03AB707-247	4.043	0.3342	0.002867	0.09128	0.2231
03AB707-248	4.025	0.2588	0	0.2039	0.2427
03AB707-249	1.819	0.2468	0.00544	0.1213	0.1636

As the results of all but one sample seemed to closely match the low K-40, Ra-226, and progeny concentrations seen in the anomalous results, this site is a potential source of the material. Note that the only result that did not match the radionuclide signature (Sample ID 03AB707-244) was collected at the surface, and not in the actual “gray road base” stratum.

November 7 to 8, 2012

Visual Comparison of B517 SU-002 Archived Soil Samples and Associated Tuna Cans

On November 7 to 8, 2012, Erik Abkemeier, Greg Joyce, and Rick Weingarz compared visual characteristics of different soil samples from the four different systematic sets collected within B517 SU-002. Samples 8 to 43 were the original set of systematics, samples 72 to 107 were the second set of systematics, samples 123 to 158 were the third set of systematics (with anomalously low K-40, Ra-226, and progeny concentrations), and samples 159 to 194 were the fourth set of systematics collected and analyzed as a result of this investigation. Because there was a comparatively small amount of remediation performed, one would not expect a significant change in the radionuclide concentration or physical characteristics within a small area. Attachment 12 provides photographs and locations of the various groupings of soil samples, both from tuna cans and excess soil sample bags.

One clear feature is that the samples from the third set of systematic samples do not appear similar in color to any of the other systematic samples, and all of the samples within the set look extremely similar, if not identical. This color uniformity coupled with the homogeneity of the low K-40, Ra-226, and progeny concentrations in an area with many visually distinct soil types within the survey unit led the investigators to conclude that the soil samples were not collected from B517 SU-002.

November 29 to December 3, 2012

Initial Investigation Report

The initial investigation report titled Investigation of Low Potassium Activity Concentrations in Soil Samples at Hunters Point Naval Shipyard is provided to the Navy and the NRC.

October 5 to 21, 2013

Update and Response to Navy Letter

On October 3, 2013, Navy management held a meeting with TtEC management to discuss a proposed update to the November 2012 initial investigation report. At the conclusion of this meeting, the Navy issued a letter (Attachment 13) on the same date requesting additional information.

TtEC agreed to reissue the initial report to include a status of corrective actions, as well as provide additional information on the investigation since submitting the initial report on November 29, 2012. The revised report incorporated the additional information requested by the Navy and updated the status of corrective actions taken by TtEC as of October 2013.

The Navy asked that TtEC identify the origin of the “low K-40” soil that may have been substituted in the sampling process (see question 1.c, Attachment 13). The investigators initially suspected the source of the “low K-40” soil was the Building 707 Triangle Area. Subsequent investigation of other potential source materials and analyses revealed that drill cuttings

consisting of greenish/grayish soil present on the ground floor of Building 253/211 have radioanalytical characteristics consistent with the “low K-40” soil. The radioanalytical results for these soil samples are contained in Attachment 14 and are summarized in Table 6.

TABLE 6
BUILDING 253/211 DRILL CUTTING SOIL SAMPLE RESULTS

Sample ID	Bi-214 (pCi/g)	Cs-137 (pCi/g)	K-40 (pCi/g)	Pb-214 (pCi/g)	Ra-226 (pCi/g)	Comments
04AB253-901	0.04346	0	0.1799	0.01653	0.02979	Green
04AB253-902	0.1198	0	3.64	0.1448	0.4302	Brownish-white
04AB253-903	0.001009	0	0.3812	0.1263	0.1748	Green
04AB253-904	0.3593	0.003745	8.103	0.4839	0.9601	Brown/White mix
04AB253-905	0.03367	-0.0001166	0.4592	-0.0007405	0.1023	Green
04AB253-906	0.1627	-0.002036	3.323	0.2025	0.3245	Dark Brown

The significance of this discovery was that if individuals decided to substitute samples from one source, it would be easier in the confines of a building where the actions are less likely to be observed by others. Either the Building 707 Triangle Area or the Building 253/211 drill cuttings, or both, may have been used as substitute soil samples, as both soil sources exhibit similar radiological characteristics. However, the investigators were unable to conclusively determine a source.

Copies of chain-of-custody forms, gamma static surveys, scan surveys, daily report information, and other ancillary information associated with the survey units listed in Tables 2 and 3 are included as Attachment 15.

Several other issues were identified through a review of survey data and chain of custody records (see request 1.d in Attachment 13):

- The same individual, Ray Roberson, was listed on the chain-of-custody form as having collected soil samples on May 31, 2012, at Survey Unit 304 at the same time he was listed as collecting soil samples at North Pier Survey Unit 11. The purpose for discussing Ray Roberson as the signatory on chain-of-custody forms is to pinpoint any unusual documentation; it is not meant to imply that Mr. Roberson was the sole cause or contributor to the anomalous data.
- Gamma static surveys were conducted in North Pier Survey Units 1, 8, 10, and 11 on May 31, 2012, from 14:52 to 16:25. The soil samples from these areas were documented as having been received at the Curtis and Tompkins laboratory from 16:12 to 16:45. If the soil samples had been collected appropriately, gamma static surveys would have been collected prior to collection of the soil samples.
- The collection of 1-minute statics in Survey Unit 1 on May 31, 2012, for 20 samples from 14:52 to 15:14 (22 minutes), Survey Unit 8 from 15:18 to 15:39 (21 minutes), Survey Unit 10 from 15:41 to 16:03 (22 minutes), and Survey Unit 11 from 16:04 to 16:25 (21 minutes) is not consistent with the typical times to collect 1-minute gamma static measurements (typically in the 28- to 32-minute range for 20 measurements). This is indicative that the gamma static measurements may have been collected in a smaller area than a typical survey unit.

- Chain-of-custody forms for the North Pier Survey Units 1, 8, 10, and 11 in Attachment 15 list the name of the sampler as “Ray Roberson,” but the chain-of-custody form for Survey Unit 304 lists the name of the sampler as “R. Roberson.”
- In the Site 707 Survey Unit 17 area, only a minor remedial action was taken. Prior to the remediation, 40 percent of the gamma static surveys exceeded the mean background plus three sigma investigation limit. On June 8, 2011, during the collection of soil samples, none of the gamma static survey measurements was above the mean background plus three sigma investigation level. This brings into question whether soil samples collected on June 8, 2011, were from the same area from which previous samples were collected.

All of the individuals who appeared to be involved based on these ancillary records are the same individuals identified as either signing as the sample collector for anomalous soil samples and/or the Health Physics Supervisor responsible for the sample collection. As such, these individuals received disciplinary action, and the associated data had already been rejected from inclusion in any FSS reports, as the associated resampling work was conducted in its entirety.

FINDINGS

The investigation was conducted to assess a discrepancy regarding the final systematic soil samples from B517 SU-002, which may not have been collected at the locations specified in the FSS report. The following are findings based on various possible scenarios that might have contributed to or caused the discrepancy:

- **Hypothesis: Did Instrument Error Cause the Discrepancy?**
 - The excellent correlation between on-site laboratory gamma spectroscopy results and the off-site gamma spectroscopy results for K-40, Ra-226, Bi-214, and Pb-214 effectively rules out instrument error as a cause for the anomalously low K-40, Ra-226, and progeny results. A comparison of onsite and offsite laboratory results is contained in Attachment 3.
- **Hypothesis: Did Laboratory Error Cause the Discrepancy?**
 - Curtis and Tompkins laboratory technicians are essentially blind of field sampling events.
 - Curtis and Tompkins chain of custody and sample control are robust and well controlled. Information provided by Curtis and Tompkins laboratory technicians corroborating chain of custody and sample control is contained in Attachment 9.
- **Hypothesis: Were the Anomalous Samples Collected at the Prescribed Depth?**
 - The idea that individuals sampling soil may have either consciously or accidentally sampled bedrock soil with low concentrations of K-40, Ra-226, and its progeny was not supported by either observations from the potholing or the subsurface sampling. Information is contained in Attachments 6 and 7.
 - No lithological evidence suggests that there is a bedrock soil layer, light gray in color and contiguous across B517 SU-002 at less than 2 feet bgs, that would account for anomalous readings in all 36 final systematic sample locations.